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Irrigation Development

IN

Western Canada



Address to

CALGARY BOARD OF TRADE

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By

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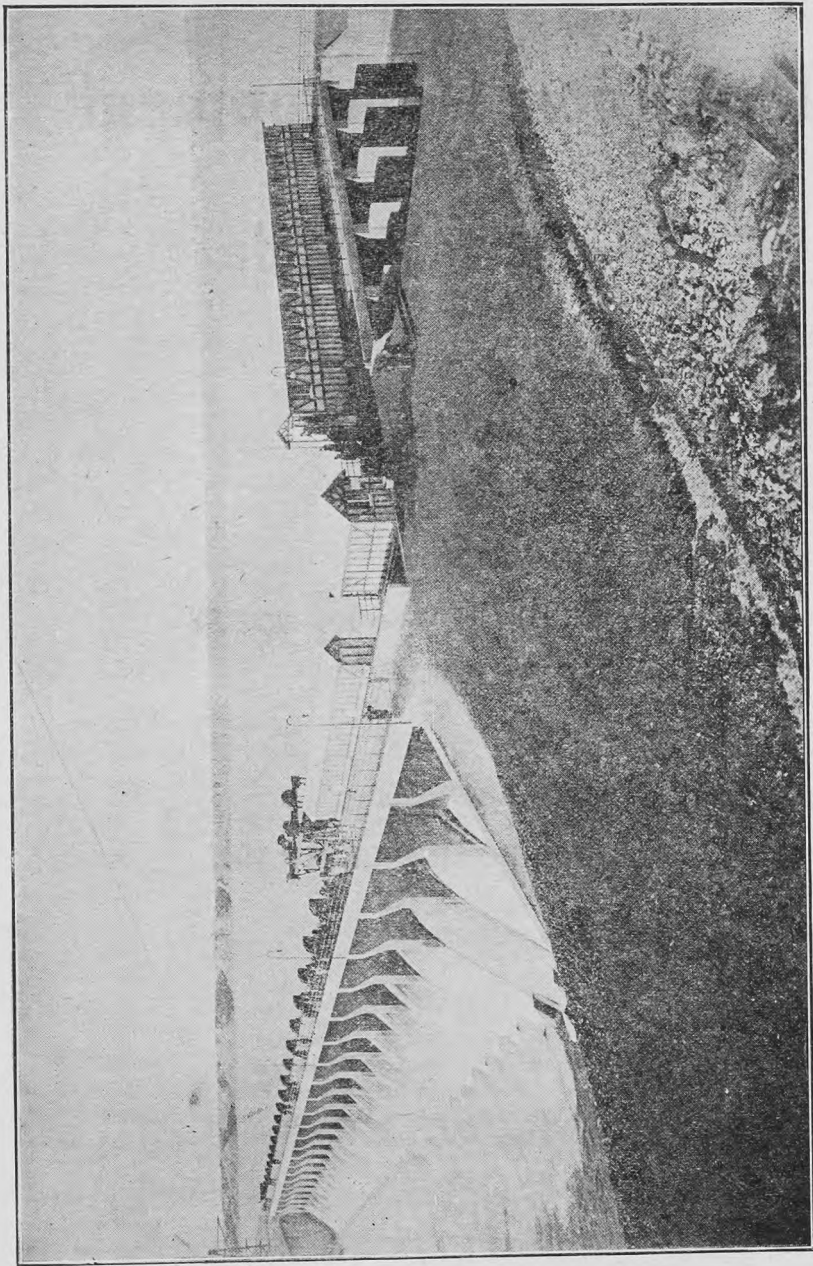
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Bassano Dam, on Bow River, C.P.R. Irrigation System, Southern Alberta. Length, 8,000 feet.
Height, 55 feet. Diverts water for 40,000 acres.

Irrigation Development in Western Canada

By

A. S. DAWSON, M.E.I.C.

It is gratifying to be able to realize that the spheres of such Boards of Trade as this are gradually widening out and functioning in a broader way, so as to be a real factor in the dissemination of knowledge and general information regarding matters which are of importance and value, not only to its own members but to the community at large. This is why I may perhaps be justified in attempting today to throw a little light on the subject of "Irrigation Development in Western Canada" which, in the opinion of well informed men, is the most important question facing a large portion of Southern Alberta today, and one of—if not the most important matters—with which the present Session of the Legislature has to deal.

It must be admitted that Calgary will grow in population and prosperity, in proportion to the growth and production of the country contiguous to it, and somewhat in accordance with the co-operative relations which exist between the City, and the urban districts of which it is the distributing centre. Moreover it would seem a foregone conclusion and fundamentally sound, that industrial development cannot economically be maintained unless such is preceded by a prosperous and fairly numerous rural population.

In the East, natural rainfall is relied on for the watering of their crops. Some times our annual rainfall amounts to little more than they are familiar with in a month, or in extreme cases in even one week.

Supplying moisture to desert and semi-arid lands by artificial means is no new thing in the enterprises of civilization, and has been practised on one portion or another of the globe since the dawn of history. It was practised by the Syrians, Egyptians, and Arabians many centuries past; and history records that the flood waters of the Nile were used to irrigate its valleys many thousands of years ago. The Romans operated vast systems which are in use at the present time; and the Chinese are credited with having put water over their rice lands by artificial means, several centuries before the Christian era.

This ancient art had its origin in America almost in pre-historic times, with the Pueblo Indians, who inhabited what are now portions of New Mexico and Arizona. Mormons settling on the shores of Great Salt Lake were the first English-speaking people to make a systematic application of the practice of irrigation in Western America; and this was shortly followed by the use of ditches in California, originally constructed for placer mining. The results obtained therefrom soon led settlers in the States of Idaho, Washington, Oregon, and Wyoming, to resort to similar means in the cultivation of their crops. This was followed by large private enterprises; and by the passing in 1902, of the Reclamation Act by the Government of the United States. This vast enterprise under the direction of the Secretary of the Interior, has now in operation or under construction, projects involving an expenditure of almost one hundred and forty-five million

dollars; and has undertaken to complete about 57 projects to serve some 3,200,000 acres of land, at an estimated cost of about \$350,000,000.

In 1918, the crops produced on 27 of these Projects in operation amounted to 67 million dollars from 1,050,000 acres of land, representing a gross return of \$63.60 per acre.

Of this: 39 per cent was from hay and forage crops,
21 per cent from cereals and seed,
17 per cent from vegetables and fruits,
23 per cent from sugar beets, cane, and cotton.

The extent at which irrigation is practised today is oft-times overlooked, amounting as it does to nearly sixty million acres in the Indian empire, ten million acres in Egypt, six million acres in Italy, three million acres in Spain, and fifteen million acres in the United States, with smaller areas in China, Japan, Australia, France, South America, Canada, and elsewhere. The works providing for the irrigation of these vast areas represent an investment of over one billion dollars, and produce annually crops valued at over that amount.

While it is only within the last few years that irrigation development in Alberta has received much publicity, it must not be supposed that irrigation in the Province is a new subject. As far back as in 1881, a few small ditches had been constructed, mostly by stock men, in order to raise forage crops for their Ranch Headquarters. From these small beginnings the use of water from streams to supplement the rainfall increased slowly, making marked advances during the dry cycles, and receiving somewhat of a setback during the subsequent cycles of heavy rainfall.

Irrigation in Southern Alberta may, however, be said to really date from 1892, when a series of dry years turned the attention of the settlers to the possibility of saving their crops by the artificial application of water. The question subsequently assumed such importance as to warrant its being taken up by the Government; with the result that well considered and comprehensive laws relative to the use of water for irrigation were passed; a system of general surveys undertaken to determine the sources of available supply; and the location of the areas where such water could be used to best advantage. These surveys showed that three extensive areas offered special advantages for irrigation; one containing some 150,000 acres situated in the Lethbridge District, which could be supplied from the St. Mary river; a second, containing about 200,000 acres, lying near the junction of the Bow and Belly rivers; and a third and much larger one, situated along the Main Line of the C.P.R., and extending about 150 miles east of the City of Calgary. It is interesting to note that the works to serve all of these tracts have either been built, or are now under construction.

For a long time there were many who claimed that irrigation was unnecessary in Southern Alberta; and it has always been more or less difficult to introduce irrigation methods in a country where the rainfall some years will produce bounteous crops.

When the first large irrigation projects were undertaken in Alberta, there were but a few visionaries who could foresee the metamorphosis of certain sections of the country, and who were able to convince others of the practicability of their ideas. They were regarded by many as Utopian, and received with scepticism on every hand. In fact the old adage "Prophets are not without honor save in their own country" was practically found to be true by many of the pioneers.

This idea is gradually changing; and as a result of several cycles of dry years, the problem now is—where can the water be obtained for the land, and how can the monies be provided to build the necessary works?

It is not a local, but a national matter, which affects a large part of Alberta, as well as part of Southwestern Saskatchewan; and therefore the Dominion as a whole.

In dealing with so large a tract of territory, there are naturally many local differences in climate, soil, and general topography; but broadly speaking, the area in which irrigation may be considered as necessary to permanent agricultural development in Alberta, is the Block between the International Boundary and the North Line of Township 28, running east and west through Drumheller; and lying east of the west boundary of Range 25, which runs north and south, through Macleod. From this, there should be excepted the higher and rougher lands on the west slope of the Cypress Hills, lying South of Medicine Hat.

The Block as described, contains about fifteen million acres of land, and the large centres to which it is tributary are Calgary, Lethbridge, Medicine Hat, and Macleod. It is not to be understood that all of this acreage can be irrigated; as some of the physical conditions, and the available water supply would not warrant such. The ultimate development of the larger portion of this Block must be under dry farming methods, with the smaller irrigated sections scattered through it, and creating centres of greater population and production, and assuring to the whole an ample supply of fodder crops, which cannot be grown on dry lands.

Within the Block described, the Canadian Pacific Railway Company's constructed projects, comprise 743,000 acres irrigable; and under the partly constructed Canada Land and Irrigation Company's project, there are about 200,000 acres irrigable. Comprehensive surveys carried on by the Dominion Government have determined that there are in addition about 600,000 acres, which could be successfully irrigated. The total irrigable land in the Block is therefore 1,500,000 acres, which is only 10 per cent of the whole Block. These figures do not represent the total acreage that may possibly some day be irrigated; but only the area commanded by the projects, either built or surveyed.

Irrigation is necessary where available rainfall is insufficient to produce profitable crops. It is desirable where available precipitation is insufficient to produce the maximum possible profitable yield per acre. The governing factor is the available rainfall during the crop season; as at other times it may actually be a detriment to successful farming operations. Water is the most essential element to the growth of vegetation. Dry farming is a misnomer, as no crop will grow without water. The essential difference between irrigation and dry farming is the quantity of the water used.

For an average crop of wheat or oats, the evapotranspiration ratio may vary from 250 to 1000 pounds of water per pound of dry matter produced; or in other words, a 20 bushel crop of wheat, or a 35 bushel crop of oats may require from 600 to 700 tons of water per acre from the soil.

So-called dry farming is the practice of the most efficient methods of the conservation of rainfall that may be available for the crops; but these same principles apply equally well to irrigation farming. The necessity or desirability of irrigation cannot always be inferred from the annual precipitation; but depends on the precipitation during the growing season.

In parts of Italy, the total annual precipitation varies from 100 to 300 inches, whereas, only from 5 to 10 inches sometimes falls during the growing season. In Assam a rainfall of over 850 inches has been known to occur in one year.

No predictions of crop yields can, therefore, be based on total annual precipitation; as the useful available moisture in any year depends on the rainfall for the few preceding years—on the distribution of the rainfall during the growing months—and on certain climatic factors, such as temperature and wind movements.

During the past 35 years, the average total annual precipitation at Calgary has been 15.87 inches; but of this only 75 per cent occurred between April 1st and September 1st, of each year.

A careful investigation of these Calgary records, between 1885 and 1920 shows conclusively that they can be divided up into dry periods of twelve years, seven years, and five years duration, and wet periods of seven and five years duration. The three dry periods comprising 24 years, showed a total precipitation about the same below normal as the two wet periods comprising 12 years showed above normal; and that during this 36 year period the dry periods were twice as long as the wet periods—or on the average there were two dry years to one wet year.

The same facts are even more evident on examining the Meteorological records at Medicine Hat, and Lethbridge. At Lethbridge, in 1910, the total precipitation was only 8 inches—of which only $2\frac{3}{4}$ inches fell during the growing season. In 1918 the total was 7.6 inches; and of this only $\frac{2}{3}$ of an inch fell during April, May and June. In 1919 the total precipitation was 12.28 inches with practically no moisture during June, July and August. In 1920, the total precipitation for the first four months was the highest on record, but the droughts from May 3rd to the end of the growing season, accompanied by extremely hot winds wrought disastrous results, as you all know.

In the Northern portion of the Province the conditions are entirely different—where the average mean precipitation varies from 25 inches to 40 inches, as compared with from 8 inches to 16 inches in the Southern portion. The precipitation varies from month to month and from year to year, and farmers never know what to expect. In certain sections of the North drainage of land is necessary, whereas in large portions of the South irrigation may be made beneficial every year.

The largest irrigation works constructed to serve portions of the area under consideration, have been built by the Canadian Pacific Railway Company, to serve 650,000 acres, east of Calgary, at a cost of about fifteen million dollars—by which water is transported through some 4,200 miles of artificial ditches; and though only partially developed, these lands produced crops in 1919 to the value of over \$6,500,000. This Company also now controls what was originally known as the Alberta Railway and Irrigation Company's System, near Lethbridge, which in 1919 produced crops to the value of $5\frac{1}{2}$ million dollars, on 82,000 acres—an average of about \$55 per acre; whereas the dry land yields were practically failures.

The Canadian Pacific Railway Company last year also constructed a system to serve some 17,000 acres of privately owned land near Taber, all of which was occupied by settlers who had been burned out for four consecutive years. In addition to these larger systems; water rights have been approved of by the Dominion Government covering about 57,000 acres in

Alberta, and 50,000 acres in Southwestern Saskatchewan, which are served by some 700 smaller works built by private parties.

Without a forecast, as to what the ultimate conditions will be, it may be assumed now that a desirable holding of dry land is something like a half section or 320 acres. A 160-acre irrigated farm is sufficient for one man with ordinary means to attempt to farm. A recent census in the United States showed that in 43 counties, in 11 States, the average irrigated farm only contained 57 acres.

No attempt is here made to deprecate the value of the so-called dry lands in Southern Alberta. Such a course would be worse than foolish, because there is only a small percentage of the land which can be irrigated; and our great main-stay must necessarily be the dry lands. The irrigated lands must, however, be considered as a valuable adjunct to the dry lands, and irrigation may be considered as a specialized line of general agriculture. As Southern Alberta dry lands have already established such world production records, it is not considered that any of the comparisons herein made, can cast any reflections on them.

It is a conservative statement, however, to make that in the Block referred to, 160 acres of irrigated land will produce as much or more than 320 acres of dry land, over a period of years; and has in addition other advantages, such as the maintenance of soil fertility, and assurance of a crop every year. Moreover, these conditions will result in the population per square mile being almost doubled. Whether we consider one farm or the whole tract, the comparatively small areas of irrigable land are a most valuable asset to the larger areas of dry lands, as they will always be the source from which the forage crops will be produced.

It is a well-known fact that during certain drouth periods, very large amounts of money have been expended in furnishing seed grain, fodder and relief to the settlers in the Districts affected.

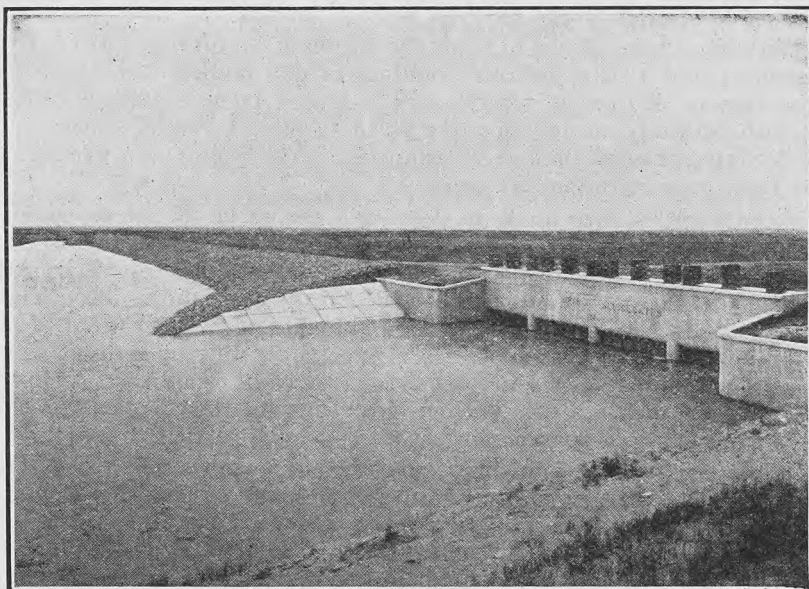
In addition to this, much was done by the Governments and Railway Companies in the way of free transportation of fodder to the stock, and stock to where feed was available.

The elevation of the irrigated area varies from 2500 to 3500 feet above sea level, and the actual growing season varies from 100 to 120 days.

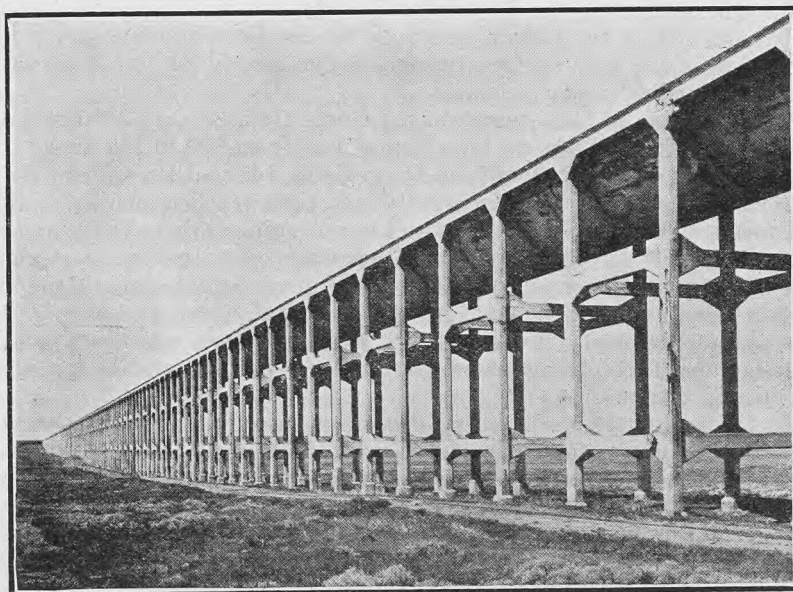
Another fact which should not be overlooked is that the soils in the arid and semi-arid sections have generally not been leached of their mineral plant foods, as have those of the more humid regions, where the heavy rains through centuries have removed these necessary constituents. An extended series of investigations carried on in the United States showed that some 300 soils from arid and semi-arid districts contained on the average three times as much potash, thirteen times as much lime, six times as much magnesia, and three times as much nitrogen—as other soils taken from more humid regions.

In the section of the country described as requiring irrigation, there are great possibilities for agriculture—just one thing is lacking, and that is sufficient natural rainfall. The soil is of great depth and as fertile as any in America. The climatic conditions will, of course, not compare with those where irrigation was first introduced in the old world; but they are as good as those in many portions of the United States, where irrigation has been successfully developed for many years.

The success which is obtaining on the irrigated lands of Southern Alberta can only be fully realized by a personal inspection of the Districts.



Dam and Secondary Canal Diversion Works, C.P.R. Irrigation System, near Bassano, Alberta.



Brooks Aqueduct, C.P.R. Irrigation System. Length 2 miles; height 60 feet. Carries water for 90,000 Acres.

The most authentic demonstration work on record are the field tests carried on at the Dominion Government Experimental Farm, at Lethbridge, covering the period from 1908 to 1918 inclusive.

COMPARATIVE RESULTS IN CROPS GROWN ON DRY LAND AND IRRIGATED LAND AT THE EXPERIMENTAL STATION, SOUTHERN ALBERTA, GIVING YIELDS PER ACRE

	Wheat		Oats		Barley (Sweet)		Peas (All)		Potatoes (Irish)	
	(Marquis)		(Banner)		Chevalier)		Varieties)		Cobbler)	
	Dry Bu.	Irr. Bu.	Dry Bu.	Irr. Bu.	Dry Bu.	Irr. Bu.	Dry Bu.	Irr. Bu.	Dry Bu.	Irr. Bu.
1908 - -	29	43	80	88	55	61	19	19	92	235
1909 - -	31	40	56	77	44	69	19	19	159	605
1910 - -	11	23	21	68	12	54	12	33	103	521
1911 - -	Hailed		Hailed		Hailed		23	39	356	508
1912 - -	28	50	77	145	41	77	31	62	296	501
1913 - -	25	52	73	115	50	93	41	42	195	483
1914 - -	24	54	49	113	25	90	19	52	400	495
1915 - -	63	94	143	81	86	80	53	50	283	447
1916 - -	48	71	118	157	64	79	46	37	475	530
1917 - -	28	48	66	128	40	82	23	48	157	465
1918 - -	14	62	24	104	17	91	16	48	93	505
Average 11 years—	30	53	70	108	43	78	27	41	237	487
Increase due to Irr.—	23 bu.		38 bu.		35 bu.		14 bu.		250 bu.	
Increase due to Irr.—	77 pc.		54 pc.		81 pc.		51 pc.		105 pc̄.	

During the 1919 and 1920 season the comparison is even more striking, as the effects of soil blowing were very much more disastrous on the dry land plots than on the irrigated ones.

However, the comparison may as well be given, and is as follows:

Increase in Wheat	per acre due to irrigation-----	29 bushels
Increase in Oats	per acre due to irrigation-----	71 bushels
Increase in Barley	per acre due to irrigation-----	42 bushels
Increase in Peas	per acre due to irrigation-----	14 bushels
Increase in Potatoes	per acre due to irrigation-----	252 bushels

In all cases (except potatoes) the results were obtained from 1/60 of an acre plots. On this account the yields are higher than would probably have been the case, had the fields been larger. The comparative results are no doubt the same, i.e., the per cent of increase due to irrigation is the same as would have been the case had the fields been larger. On the irrigated land the grain crops were grown on land that had raised a hoed crop of some kind the year previous, and the potatoes were usually planted on grain land.

In comparing results of the yields in grain on this farm, on the dry and irrigated lands, it is only fair to point out that on the dry land, the crops were invariably planted on summerfallowed land; so that to be really fair in the comparison, the yields on the dry lands should be divided by

two—for, on the irrigated land a rotation system was followed, and no summerfallow was done; that is to say—a crop of some kind was produced every year on the land.

The Superintendent of the Farm emphasizes the fact that at no time since its establishment has any effort been made to demonstrate the advantages of irrigation over dry farming, but two farms in reality were operated, and all possible efforts made to obtain the best results on both. (The results obtained are self evident.) He also states that comparative yields of timothy and alfalfa are not given, for the reason that the returns from these crops have been so low on the dry land, that it was hardly thought worth while to tabulate them.

On the irrigated portion of the station their average yield for cured alfalfa for the past ten years has been considerably over four tons per acre; some seasons it has exceeded five tons. Timothy hay has averaged from 1½ to 2 tons per acre during the same period.

Irrigation spells diversification and more intensive farming than is the case with straight grain growing on dry land. To be able in our short seasons to irrigate the crops in the most advantageous manner and at the proper time they must be diversified and so arranged that it will not be necessary to irrigate the whole area at one time, as would be the case were one raising grain exclusively. This diversification means that there will be certain parts of the farm devoted to hay and pasture, and means that the live stock holdings will be vastly increased; and with the carrying of live stock on the land the question of an adequate supply of humus in the soil will be solved. This in itself will modify to a great extent the troubles we are experiencing in soil drifting. The weed problem can be better taken care of, because the weeds that thrive in grain disappear when the land is seeded to alfalfa; and when the land has been seeded down to alfalfa for a few years it is richer than ever for grain growing, and more stable and permanent conditions are established.

The natural outcome of this change of conditions will without doubt mean smaller holdings and larger population. It will mean better roads and better schools; and social conditions generally will be improved, as a result of greater production per annum per acre.

A conservative estimate of the additional cost per acre for farming under irrigation methods is from \$4.00 to \$5.00 per acre, including the cost of land preparation, ditching, and irrigating, the ordinary maintenance charge of about \$1.00 per acre, and interest on the additional purchase price of irrigable land over dry land.

The Canada Land and Irrigation Company has published reports on an irrigated farm, containing 84 acres, being operated by their Company, on which, in 1918, the net profit was \$4,254; the crops being alfalfa, field peas, potatoes, corn and garden truck, and the water was all pumped to the land. The gross value of the crops produced on this farm, were as follows:

1918 -----	\$116.00 per acre
1919 -----	119.00 per acre
1920 -----	113.00 per acre

During the years 1915, 1916, 1917 and 1918 the same Company carried on a series of experiments in conjunction with the Irrigation Department of the Dominion Government on crops, including alfalfa, wheat, oats, barley, peas, potatoes, and sugar beets, on both dry and irrigated plots. Applying their results to a one hundred and sixty acre tract, containing

100 acres of alfalfa, 30 acres of oats, 10 acres of barley, 10 acres of peas, 5 acres potatoes, and 2 acres of garden produce, the average increase per acre was as follows:

1915-16 (two wet years) -----	\$30.36 per acre
1917-18 (two dry years) -----	79.06 per acre
1915 to 1918 (average for four years) -----	51.00 per acre

Probably the largest returns ever produced from 12 acres in the prairie provinces were those obtained in 1919, by a farmer near Brooks, Alberta, who obtained 14 bushels or 784 pounds of alfalfa seed to the acre. This was sold at 85 cents per pound, representing a return of \$666 per acre, or \$7,992.00 from the 12 acres. The price subsequently advanced to \$1.00 per pound. Field peas grown on a large scale in the same district have produced as high as \$200 per acre, and clover seed to an equal amount.

The gross value of crops produced on the Provincial Government Farm near Lethbridge during 1920, has been given out as \$36,197 from 546 acres, an average of \$66.30 per acre.

The results which have been obtained in the past, with sunflowers for silage, producing as high as 30 tons per acre; with sugar beets of exceedingly high sugar content, producing as high as 25 tons to the acre; and with alfalfa, field peas, and clover seed, are only possible under irrigation methods.

After referring, somewhat generally, to results on irrigated land so far obtained in Southern Alberta, let us turn to the future. The policy of the Dominion Government has been to make the surveys to determine the feasibility of developing certain areas under irrigation, but has never undertaken any actual construction. This phase of development was handled by Companies, who held large Blocks of vacant land, constructed the works to serve them with water, and then sold to new settlers, with a perpetual contract for a supply of water to the lands, at a fixed annual charge. This form of enterprise has developed all the large projects constructed up to date. These conditions are now changed, because the large areas that still await development are practically all settled, and the people are on the land. The proposal is to develop these areas by co-operative effort of the land owners themselves; and the necessary machinery has been created by the Provincial Government in passing the Irrigation District Act.

In short, this Act provides for the formation of Irrigation districts, with power to raise the necessary funds to construct the Irrigation works by selling bonds, the security for which is the land within the district. In principle, the method proposed for handling these districts is not unlike that which has been used under the Drainage District Acts of Ontario, and some of the other Provinces. It is somewhat similar to a Municipal Form of Organization, and its development may in some measure be due to the somewhat popular idea of bringing more of the public utilities under public control.

This Act was amended in April, 1920, and is based on the best features embodied in similar Acts formerly drafted in the United States.

Among its outstanding features are the appointment (by the Lieutenant Governor) of an Irrigation Council, who may forbid any Act or course of conduct proposed to be done or entered upon by the Board of Directors, and without whose authority no expenditure can be made on any debenture issue nor any contracts for construction awarded. All debentures issued

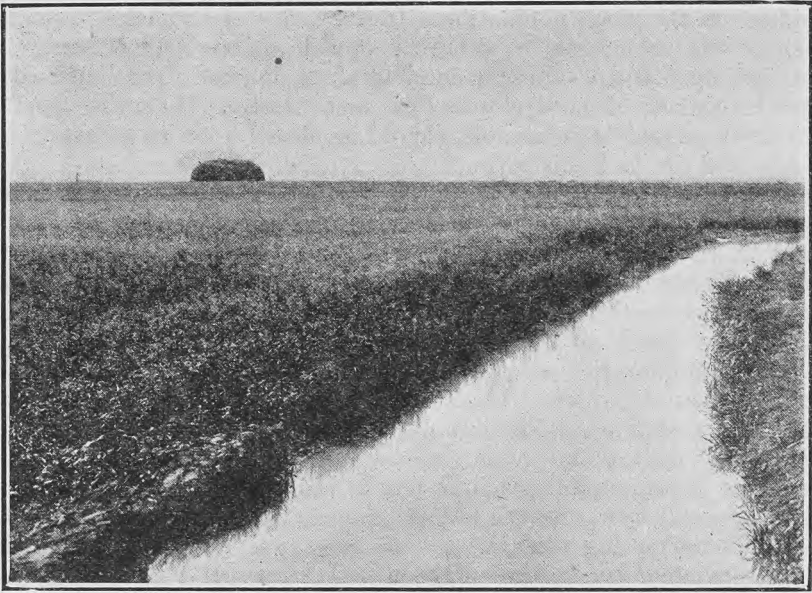
under the Act referred to, must provide for the payment of the whole principal money within thirty years from the date of the issue thereof, and shall be repayable by annual instalments extended over the whole of such period, or not less than the last twenty years thereof, and the sale of debentures and rates of interest are subject to the approval of the Provincial Government.

This proposed method of development is new in Alberta, but has made very rapid strides of late, no doubt due in part to the psychological effects of the last four very dry years. The Taber Irrigation District, which will irrigate 17,000 acres by an extension of the Canadian Pacific Railway Company's project, near Lethbridge, will be put into service this summer. The cost of the works will be repaid the Railway Company in the form of debentures bearing 6 per cent interest, and repayable in 20 equal annual instalments. The cost of operating and maintaining the system will be met by the settlers; and the Company's responsibility ends with delivering to the Main Headgates, the gross amount of water necessary for the land under the terms of the Irrigation Act, for which they will receive a fixed sum per acre, per annum.

These irrigation districts cannot make much further progress towards construction until they are successful in interesting capital to purchase their Bonds. If Bond buyers carefully investigate the advantages of Western Canadian Irrigation Bonds in the light of the success which has attended irrigation projects now in operation, they will probably realize their investment values, and the sound financial credit to which they are entitled, and particularly if such debentures have the guarantee of the Provincial Government. It is recognized that the present, with its unreasonably high cost of construction materials and labor, may not be the best time to undertake the large construction work involved; but, whether the proper time to construct be today or not, the question is a serious one, and must be worked out in some way. Many of these people have had three and four crop failures and cannot stand another; and unless some means are devised to build these works and get the water on the land, these Sections are going to be abandoned, with serious consequences to the country as a whole. It is going to be a case of irrigation or emigration. These systems should be constructed even if the lands were not settled, and particularly for the reason that they are already occupied. The suggestion has been made that these people be moved to certain districts in Northern Alberta, which are not subject to drought. Such an idea is preposterous.

In addition to their own homes and improvements there are the schools and churches—the road improvements—the telegraph and telephone service—the railways and other facilities on which large sums of money have been spent. Then there is the human element which must be given consideration. There are thousands of settlers on these lands who have gone through the pioneering stage once—and that is quite enough for most people — and who have invested everything they had in endeavors to make a home, and spent years in so doing. The nails placed in those houses were driven with hope and aspirations for the future; and it would be a calamity to any country to have the fact spread broadcast that large areas of this province were virtually being abandoned due to lack of moisture and to disastrous winds.

The rivers of Southern Alberta are among its most valuable natural resources, and the rational thing to do is to divert this water to these lands,



Irrigated Mixed Pasture Grasses, near Brooks, Alberta



Irrigating Potatoes near Duchess, Alberta

and not move the people from them. Moreover, the towns and villages are dependent on the rural population. If the latter are depleted what is to happen to the urban centres, where people have established homes, and capital has opened up stores, banks, elevators, lumber yards, and all the various industries which are found in such places. The mere fact that irrigation development is possible, should be looked upon as an asset to the province, and not as a misfortune.

The truth of the matter is that the real facts are not generally known, and that many people have not realized the potential productive capacity of these tracts when brought under irrigation, nor yet got the right viewpoint on this important question, viz., that irrigation farming is the most intensive, most successful, and most profitable form of scientific agriculture.

Irrigation Bonds in the United States have at different times not met with favor—not through any fault of their own—but because of the many basically unsound projects which have been launched by promoters of Land-selling Companies. The laws, both Federal and State, effecting irrigation were complex and comprehensive. There arose an early conflict between the Riparian rights of the humid regions in accordance with the English Common Law, and the law of necessity in the arid regions—which held that water, being essential to existence, was the property of those who appropriated it. In the early days the users of water were apt to protect their rights in the usual effective manner; so that the stealing of water was a heinous offence, classed along with horse-stealing, and likely to meet the same punishment.

The main causes of so many financial failures in the United States are not difficult to trace, and may be summarized as follows:

1. Lack of thoroughness in making preliminary surveys;
2. Under-estimating the cost;
3. Lack of proper State and Federal supervision;
4. Slow rate of settlement;
5. Allowing settlers to make their homes on the land before the completion of the projects.
6. Ignorance on the part of the prospective settlers, and the difficulty of overcoming really desert land;
7. Requirements that the water right be paid within the period of ten years, or less.

Conditions in Canada are different, however, and there are not the same chances for disaster. The Government controls all the water, and for many years have, under their Hydrometric Branch, kept careful records of all streams. No works can be constructed without Government sanction, based on thorough engineering investigations as to the feasibility and soundness of the projects, and their approval of the construction details. The Government even goes farther and gives approval on their part of the character of the lands to be classified or sold as irrigable.

The officials who created the Dominion Government laws which control all Irrigation Developments in Alberta were wise enough to profit by the mistakes which had already been made in the United States; and Canada can claim of having laws in existence which insure that no wild-cat schemes can be developed. This is a point of very great importance, because what is needed at the present time is the capital to develop new

projects; and there may still be in the Eastern money markets a certain air of suspicion regarding Irrigation Bonds.

All the further developments now being proposed have been surveyed by the Dominion Government; and following out the spirit of these excellent laws, it is probable that never before have more careful investigations been made in connection with measuring the available flow of streams and making preliminary instrumental surveys. The present Irrigation Act of Canada is believed to embody such of the best principles of the Irrigation Laws of other countries as are applicable to local conditions in Western Canada, and to be free from most of the defects of those laws. This Act applies to the Provinces of Alberta and Saskatchewan, and its essential features are:

1. That the water in all streams, lakes, springs, ponds, or other surface sources of water supply, is the property of the Dominion Government.
2. That the right to use this water may be obtained by Companies or individuals upon compliance with the provisions of the law.
3. That the uses for which water rights may be so acquired are:
 - (a) Domestic, which includes household and sanitary purposes, and all purposes connected with the watering of stock, and the operation of agricultural machinery by steam.
 - (b) Industrial, i.e., the operation of railways and factories by steam.
 - (c) Irrigation.
 - (d) Other purposes than those above mentioned.
4. That the individual or Company acquiring such a water right shall be given a clear and indisputable title to the right to the use of the water so long as he shall continue to apply it to a beneficial use.
5. That such rights may be forfeited by abandonment, waste, or non-use.
6. That holders of water rights shall have the protection and assistance of permanent Government officials in the exercise thereof.

A diagram showing the actual monthly rainfall in Southern Alberta is all ups and downs; the production on the so-called dry lands shows these ups and downs; and following that our business conditions are all ups and downs. The financial conditions of the individual farmers are reflected in the financial conditions of the country. Agriculture is the basic industry of this section of the country. Irrigation stabilizes agricultural production, and therefore stabilizes business conditions. It is not so much hail insurance or frost insurance we require as drouth insurance; and this can only be provided by the construction and operation of well designed and well built irrigation systems. I have been well informed that a mortgage has rarely been foreclosed on an irrigated farm in Southern Alberta; and in the South-easterly portion of the province it is now generally conceded that a full water right fully trebles the selling value of a farm. If you take the 1,500,000 acres previously mentioned as capable of being put under irrigation in the Southern portion of this province—the largest portion of which is occupied, and assume a low average price of \$30 per acre for the so-called dry land—the increased value of this area on the 3-1 basis would amount to \$90,000,000.

To summarize:

The chief benefits of irrigation in Southern Alberta may be stated to lie in the following directions:

1. As providing a valuable insurance against losses from drouths which are known to occur at certain periods of each year, and long drouths which do occur in certain seasons.
2. The production of large yields of grain with the application of water at critical periods in its growth.
3. The production of larger yields of alfalfa, timothy, and other fodder crops, necessary for the upbuilding of the live stock industry, and the general adoption of mixed farming methods.
4. Additional population on smaller holdings, and the possibility of creating better homes on the treeless plains.

In short it means permanent agricultural development on a sound basis, versus an existence where the profits of one or two bounteous crops have to be made use of to help stave off privation and actual hardship for the settler and his family.

A very conservative estimate of the value of the grain, forage, and garden truck grown on the C.P.R. Irrigation Systems alone during 1919 and 1920 is \$22,600,000.

Moisture is the basis of agricultural success in Southern Alberta, as it has been in all other semi-arid countries; and this is what leads up to the tremendous importance of the matter of the financing of these irrigation projects.

Mr. C. A. Magrath, Chairman of the Canadian Section of the International Joint Waterways Commission and Fuel Controller during the war, made the statement before the Lethbridge Board of Trade on May 24th, 1919, that in his opinion no enterprise in the East or West would yield greater wealth to Canada than an expenditure of \$20,000,000 on irrigation development in Southern Alberta at the present time.

The President of the Canadian Pacific Railway, in his annual report to the Directors on May 5th, 1920, stated that "the success of the Company's Irrigation undertakings, combined with the necessities of that portion of the country, should lead to the extension of irrigation projects under the auspices of the Federal or Provincial Governments."

Everything that follows in the wake of increased population is an argument in favor of irrigation, and the intensive cultivation of smaller areas which can only be carried out by this means of farming. Moreover, this results in a better type of farmer, greatly improved living conditions, and correspondingly elevated social conditions.

Of Western Canada it has been truly said that "The first foot of soil in the three prairie provinces is its greatest heritage, worth more than all the mines in all the mountains from Alaska to Mexico, and more than all the forests from the United States boundary to the Arctic seas—rich as they are; and next in value to this heritage is the three feet of soil which underlies the first."

With the irrigated areas constantly growing and ordinary agricultural development proceeding there is no reason why Southern Alberta as a whole should not be one of the most productive portions of Canada.